COBALT COMPOUNDS

Cobalt compounds are federal hazardous air pollutants and were identified as toxic air contaminants in April 1993 under AB 2728.

CAS Registry Number: 7440-48-4 Co

Molecular Formula: Co

Cobalt is a silvery, gray, hard, magnetic, ductile, and somewhat malleable metal. It exists in two allotropic forms (hexagonal and cubic) at room temperature. Cobalt can be formulated as alloys, brass and steel (HSDB, 1991). It is soluble in nitric, hydrochloric, and sulfuric acids, but is not soluble in water. There are several radioactive isotopes and the hydrated salts of cobalt are red (Merck, 1989).

Examples of Cobalt Compounds

Cobalt acetate	Cobalt diacetate	Cobalt oxide
Cobalt alloy	Cobalt hydrocarbonyl	Cobalt resinate
Cobalt amide	Cobalt molybdate	Cobalt sulfate
Cobalt arbonyl	Cobalt nitrate	Cobalt sulfide
Cobalt azide	Cobalt nitride	Cobalt tetrahydrate
Cobalt bromide	Cobalt nitroprusside	Cobalt trifluoride
Cobalt chloride		

Physical Properties of Cobalt

Synonyms: CI 77320; kobalt; NCI-C60311; aquacat

Atomic Number:	27
Atomic Weight:	58.93
Valences:	1,2,3 rarely 4,5
Boiling Point:	2870 °C
Melting Point:	1493 °C
Density/Specific Gravity:	8.92 at 20 °C
Vapor Pressure:	0 mm at 20 °C

(HSDB, 1991; Merck, 1989; Sax, 1989)

SOURCES AND EMISSIONS

A. Sources

Cobalt is mainly emitted from sources where it is used in the production of steel and alloys, especially in superalloys used in aircraft engines and gas turbines, and in magnetic materials which are used for various electronic applications. Cobalt is also used in the production of cobalt bearing alloys, cutting materials, wear-resistant materials, lacquers, varnishes, and paint driers. It is also used in the production of inks, enamels, frits, glazes, glass decolorizers, and catalysts (HSDB, 1991). The primary stationary sources that reported emissions of cobalt compounds in California are automotive repair shops, crushed and broken stone mining, and miscellaneous repair shop services (ARB, 1997b).

Cobalt has also been identified but not quantified in motor vehicle exhaust by the Air Resources Board (ARB) (ARB, 1991e).

B. Emissions

The total emissions of cobalt compounds from stationary sources in California are estimated to be at least 84 pounds per year, based on data reported under the Air Toxics "Hot Spots" Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

Cobalt is found in the earth's crust at 0.001-0.002 percent and is found in cobalite, linnacite, smaltite, and erythrite (Merck, 1989). It is a by-product from nickel, copper, silver, lead, and iron ore refining. Green, leafy vegetables may contain concentrations as great as 0.5 milligrams per kilogram of dry weight (HSDB, 1991).

AMBIENT CONCENTRATIONS

Cobalt and its species are routinely monitored by the statewide ARB air toxics network. The network's mean concentration of cobalt (including its species) from January 1996 through December 1996 is estimated to be 8.0 nanograms per cubic meter (ng/m^3) (ARB, 1997c). The United States Environmental Protection Agency (U.S. EPA) has also compiled data on ambient concentrations for cobalt in the South Coast Air Basin. The U.S. EPA has estimated a mean concentration of 1.1 ng/m^3 during 1985 with a range of concentrations of 1.0 to 1.1 ng/m^3 (U.S. EPA, 1993a). In another study, cobalt concentrations in the ambient air during the production of cobalt salts showed mean concentration values between 49 and 1,046 micrograms per cubic meter (HSDB, 1991).

INDOOR SOURCES AND CONCENTRATIONS

In a field study conducted in southern California, investigators collected particles (PM_{10}) inside 178 homes and analyzed the particle samples for selected elements, including cobalt. Two consecutive 12-hour samples were collected inside and immediately outside each home. Cobalt was present in measurable amounts in less that 10 percent of the samples (Clayton et al., 1993).

ATMOSPHERIC PERSISTENCE

Cobalt compounds are expected to be particle-associated in the atmosphere, and hence subject to wet and dry deposition. The average half-life and lifetime for particles and particle-associated chemicals in the atmosphere is estimated to be about 3.5 to 10 days and 5 to 15 days, respectively (Balkanski et al., 1993; Atkinson, 1995).

AB 2588 RISK ASSESSMENT INFORMATION

Although cobalt compounds are reported as being emitted in California from stationary sources, no health values (cancer or non-cancer) are listed in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program Revised 1992 Risk Assessment Guidelines for use in risk assessments (CAPCOA, 1993).

HEALTH EFFECTS

The primary route of human exposure to cobalt is inhalation (HSDB, 1991).

Non-Cancer: Inhalation exposure to cobalt may cause respiratory effects such as irritation, wheezing, asthma, pneumonia, and fibrosis. Cardiac effects, congestion of the liver, kidneys, conjunctiva, and immunological effects have also been noted (Sittig, 1991; U.S. EPA, 1994a).

The U.S. EPA has not established a Reference Concentration (RfC) for cobalt and the Reference Dose (RfD) is under review (U.S. EPA, 1994a).

No information is available on adverse reproductive or developmental effects of inhalation exposure to humans. In one oral study, no adverse developmental effects on human fetuses were observed following treatment of pregnant women with cobalt chloride. In test animals exposed to cobalt by inhalation, adverse effects observed were testicular atrophy, decreased sperm motility, and an increased length of estrus cycle. Oral exposure has been reported to cause stunted growth and decreased survival of newborn pups. These effects occurred at levels that also caused maternal toxicity (U.S. EPA, 1994a).

Cancer: The U.S. EPA has not classified cobalt with respect to potential carcinogenicity (U.S. EPA, 1994a). The International Agency for Research on Cancer has placed cobalt in Group 2B: Possible human carcinogen (IARC, 1991a). The State of California has determined

under Proposition 65 that cobalt metal powder and cobalt (II) oxide are carcinogens (CCR, 1996).